

Population Dynamics

Population Size

- Population size is estimated using sampling techniques (because can't count every individual) through counting the number of individuals in the larger overall area
- Signs of a healthy population
 - Population increases or remains steady
- Signs of an unhealthy population
 - Population size declines quickly (which can lead to extinction)
- The population size can decrease, increase, follow a cycle, or remain the same
- Doubling time

Rule of 70

A trick to estimate population doubling

$$\text{Doubling Time (years)} = \frac{70}{\% \text{ Growth Rate}}$$

$\left(\frac{70\%}{(10\% \text{ per year } \times 7)}\right)$ or $\left(\frac{7}{(1\% \text{ annual } \times 10)}\right)$ = Doubling time (year)

For example: $\frac{70}{5} = 14 \text{ years}$

Population Density

- Low population densities and high population densities
- Larger organisms have lower population densities because they require more resources (thus more room)
- Density makes it easier for organisms to group together and find mates
- Higher density...
 - Leads to conflict as individuals compete for resources
 - Makes species more vulnerable because they are in close contact and therefore more infectious diseases can be easily transmitted
- Low density...
 - Organisms benefit from more space
 - ... but have a harder time locating mates and companions

Population Distribution

- Three distributions

Random Distribution
 In a random distribution, individuals are distributed in a space in a way that is unpredictable. This type of distribution is common among organisms that live in a uniform environment, such as dandelions in a meadow. The distribution of individuals is determined by chance, and there are no obvious patterns or trends.



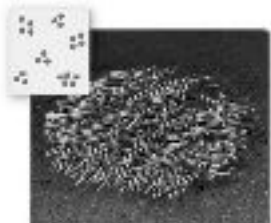
Dandelions

Uniform Distribution
 A uniform distribution is a type of distribution in which individuals are evenly spaced in a given area. This is often the result of territorial behavior or competition for resources. A classic example is the distribution of penguins on a beach, where each penguin maintains a certain distance from its neighbors to avoid conflict.



Penguins

Clumped Distribution
 A clumped distribution is a type of distribution in which individuals are grouped together in a given area. This is often the result of social behavior or the presence of resources that are concentrated in certain areas. A classic example is the distribution of trees in a forest, where trees are often found in clumps or stands.



Red Clumped

The Role of Scale
 The distribution of individuals in a population can change depending on the scale of observation. For example, a population of trees in a forest may appear clumped at a small scale, but more uniform at a larger scale. This is because the distribution of individuals is determined by local factors, such as soil conditions and competition, which vary across the landscape.

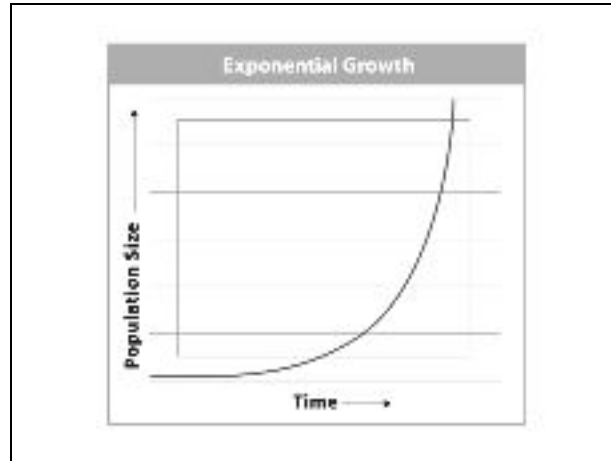


Red Clumped

Population Growth

- Two factors influence population: births and deaths, and immigration and emigration
- When a population's birthrate is greater than its death rate, the population size increases

- When a population's death rate is greater than its birthrate, the population decreases
- Calculating population growth → tells us the net change in a population
 - (individuals added) - (individuals subtracted) or (birthrate + immigration rate) - (death rate + emigration rate)
 - Shrinking populations have negative population growth
 - Positive population growth indicates the population is getting larger
- Two basic patterns of population growth
 - Exponential
 - When a population increases by a fixed percentage each year

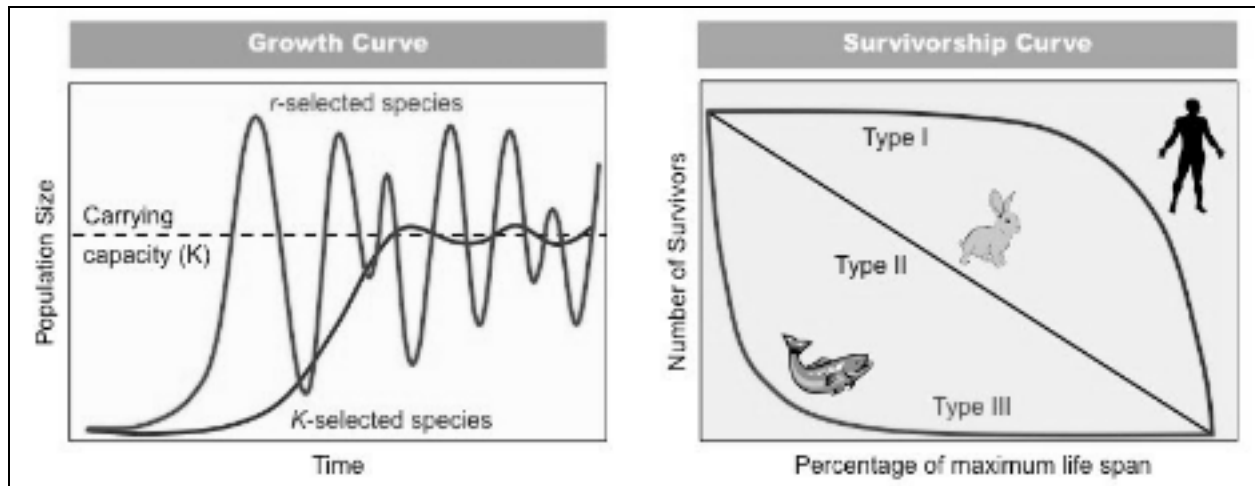
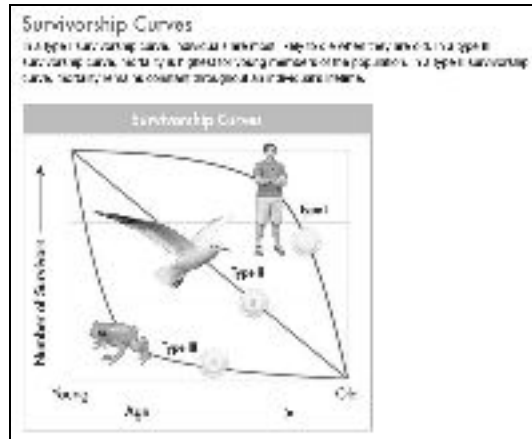


- Logistic
 - Exponential growth rarely lasts long



- Limiting factors determine a population's carrying capacity

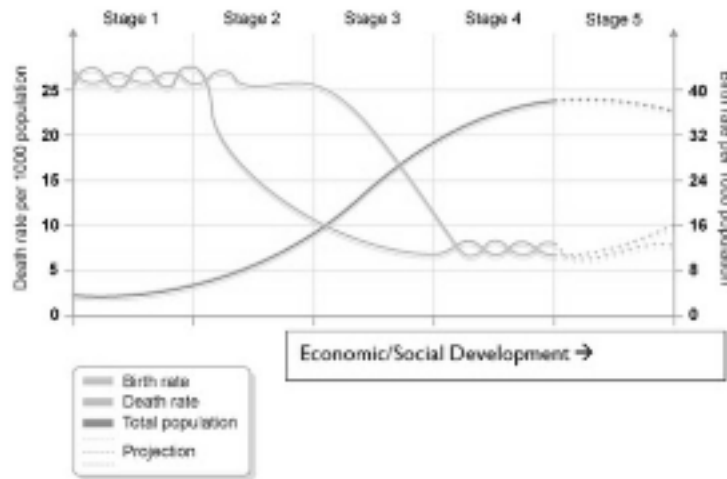
R & K Species



r	K
Unstable environment, density independent	Stable environment, density dependent interactions
small size of organism	large size of organism
energy used to make each individual is low	energy used to make each individual is high
many offspring are produced	few offspring are produced
early maturity	late maturity, often after a prolonged period of parental care
short life expectancy	long life expectancy
each individual reproduces only once	individuals can reproduce more than once in their lifetime
type III survivorship pattern in which most of the individuals die within a short time but a few live much longer	type I or II survivorship pattern in which most individuals live to near the maximum life span

Demographic Transition Model

- The Demographic Transition Model (DTM) is based on historical population trends of two demographic characteristics (birth rate and death rate) to suggest that a country's total population growth rate cycles through stages as that country develops economically



Vocabulary

- Population size: (n.) the number of individual organisms present in a given population of the time.
- Doubling time: (n.) time it takes for a population to double in size
- Population density: (n.) the number of individuals within a population per unit area.
- Population distribution: (n.) how organisms are arranged within an area
- Natality: (n.) the rate at which individuals are born
 - # of births/1000 individuals
- Mortality: (n.) the rate at which individuals die
 - # of deaths/1000 individuals
- Survivorship curves: (n.) the likelihood of death varies with age
- Immigration: (n.) the arrival of individuals from outside a given area
- Emigration: (n.) the departure of individuals from a given area
- Migration: (n.) Seasonal movement into and out of an area
- Carrying capacity: (n.) Largest population size a given environment can sustainably support
- Limiting factors: (n.) characteristics of the environment that limit population growth